ON PETALODY OF THE OVULES AND OTHER CHANGES IN A DOUBLE-FLOWERED FORM OF "DIANELLA CÆRULEA"

A SPECIMEN, kindly forwarded me by Baron Sir Ferd. von Mueller, of a double-flowered *Dianella cærulea*, has several points of interest. It is an addition to the scanty list of double-flowered plants from the southern hemisphere; it is of interest as having suggested to Robert Brown the establishment of a new species, as was kindly indicated to me by Mr. Baker, while the structural peculiarities it presents are specially worthy of note. With regard to the first point, subsequent experience has shown that the late Dr. Seemann's assertion that there was not "a single double-flowered species known from the southern hemisphere," except *Rubus rosifolius*, no longer holds good, and, indeed, the number of specimens that have from time to time been forwarded to me by Sir Ferdinand von Mueller from various parts of Australia, leads me to believe that such variations are as common in wild Australian plants as in wild European ones, and that, if there be any defect in this particular, it is more apparent than real, and arises partly from insufficient observations, and partly from the relatively smaller number of cultivated plants in Australia. One such instance, that of *Tetratheca ciliata*, presented such features of interest that I made it the subject of a note in your columns, December 7, 1882.

Robert Brown's *Dianella congesta* (*R. Br. Prod.*, 280) is described by Mr. Baker in his systematic summary of the Asparagaceæ (*Journ. Linn. Soc.*, xiv., 1874, p. 576) as having the flowers arranged in dense tufts, in which it differs widely from all the other species of the genus. Mr. Baker expressly says that he had only seen immature flowers. In the "Flora Australiensis," vol. vii., 1878, p. 16, Mr. Bentham alludes to the plant in the following terms:—"*Dianella congesta* . . . appears to me to be a form of *D. cærulea* with dense sessile cymes; the inflorescence, however, in the specimen preserved is scarcely developed, and almost destroyed by insects." The examples sent by Sir Ferdinand von Mueller are, fortunately, in better condition, although, being dried and pressed, they afford little or no opportunity of examining the early stages of development.

Dianella cærulea, as grown in greenhouses in this country, is an elegant perennial plant with grass-like foliage and loose, much-branched cymes of bright blue flowers. Each flower is about half an inch in diameter, and consists of a coloured perianth of six oblong, obtuse segments in two rows; each of the outer segments has five prominent convergent ribs, the inner ones have three only. Within the perianth is a row of six stamens, three of which are placed before the three outer, and three before the three inner perianth-segments, from the base of which they are, indeed, not entirely free. These stamens are remarkable for their thick, club-shaped, fleshy filaments, which support a two-lobed anther opening at the top of each lobe by a terminal pore. The ovary consists of three carpels alternating with the inner row of stamens, and are thus opposite to the sepals, and consolidated into a three-locular ovary with axile placentation, and with numerous ovules in each loculus, the horizontally-disposed ovules being arranged in two longitudinal lines. The ovary ripens into a fleshy ovoid or oblong berry of a lovely blue colour, and containing a relatively small number of seeds as compared to the number of ovules. Indeed, according to the published figures there is much variation in the number of the ripe seeds, abortion of a large proportion being apparently the rule.

So much relating to the usual conformation of the flower is necessary for the comprehension of the changes met with in the malformed specimens. The first thing that strikes attention in them is the substitution of masses of flowers densely crowded into glomerules in place of the light, loosely branching panicled cyme met with under normal circumstances. These glomerules look like little "Brussels sprouts," but their constituent parts are somewhat fleshy, and rich cobalt blue in colour. It was this crowded condition of the flowers that doubtless suggested the name "congesta," applied to this form by Brown. On examination of the individual flowers, many changes are observable, and scarcely two flowers present exactly the same characteristics. In most cases a multiplication of the perianth-segments has taken place at the expense of the stamens and carpels, but few or no intermediate forms are met with between petals and stamens, or petals and carpels, neirher are there any indications of staminody of the carpels or the converse. Very frequently the thalamus, or axis of the flower, after having given off several alternating whorls of segments, divides into three or more divisions, each of which, in its turn, gives off successive whorls of densely imbricating blue segments.

The most interesting changes, however, are to be sought in flowers which have not undergone such a serious amount of perturbation as those above-described, and of these a few may be found here and there wedged in among their more full-blown companions. Unfortunately the flowers are so densely packed, and the state of the specimen such, that nothing can be learnt as to the relative position on the inflorescence of these less distorted flowers. The perianth in these cases is normal, but the stamens present some significant changes. The thickened fleshy filament is replaced more or less completely by a slender ribbon-like stalk, not, as in the natural state, continuous with the base of the anther (basi-fixed), but attached to the back of the anther, a little above its base (dorsi-fixed). This would seem to be an indication that the thickened portion of the filament in the ordinary flower is really an anther-lobe in a state of arrested development.

It will be remembered that Clos and also Goebel are of opinion that the anther is a distinct organ, without direct relation to the lamina of the leaf, and the first-named author considers the filament and its continuation the connective, to be the representative of the median nerve of the petal (Clos: "la feuille florale et le filet staminal"). It would occupy too much space to enter into a discussion on this point: suffice it to add that, in addition to the other changes noted, the anthers in these flowers open by longitudinal slits at the sides, and not by pores. The ovary presented different conditions in different flowers. In almost every case it was preternaturally enlarged, in some instances it was converted from a trilocular to a unilocular condition, owing to the edges of the carpels remaining "valvate," and not inflected, the placentation, of course, in such cases, being parietal, not axile. In other flowers the ovary was represented by three separate, but closed carpels, a retention of juvenile or primordial character, and which, probably, may also be taken as an indication of the condition of the carpels in the progenitors of the Liliaceæ.

But these changes in the carpels are of less interest (owing to the greater frequency of like mutations in other flowers) than are the appearances presented by the placenta and by the ovules, changes unlike anything that has been observed in Monocotyledons, so far as I am aware. These changes in the placenta in the case of the closed unilocular carpels consisted in the outgrowth from the ventral suture of two narrow, parallel, longitudinal plates of a bright blue colour, extending the whole length of the carpels. In flowers in which this petalodic condition of the placenta was present there were no ovules. Are these petal-like processes to be considered as outgrowths from the ventral suture—*i.e.* of foliar origin—or are they to be regarded as springing from the thalamus (axial), and congenitally adherent to the edges of the carpel? Unfortunately there is no means of obtaining a definite reply

to this question. They look as if they were outgrowths from the margins of the carpellary leaf, and I should probably have considered them to be so were it not for certain appearances in the ovules to which I proceed now to allude. In the free carpels, in the flowers I examined, no ovules were apparent, but only the petaloid plates just described; but in those cases where the carpels were combined into a trilocular ovary, the ovules were present on each side of the ventral suture, not indeed in a perfect condition, but in a more or less abortive state, consisting merely of a funicle and an irregular plate of cellular tissue more or less blue in colour, the only representative of the coats of the ovule, while the nucellus, so far as I could see, was entirely wanting. Still, the general appearance was that of imperfectly developed, pendulous, anatropal ovules.

Petalody, and especially phyllody, of the ovules is not a very uncommon phenomenon among Dicotyledons, and their peculiarities have been discussed at length in numerous classical treatises, to which it is not necessary here to refer. The corresponding changes in the ovules of Monocotyledons must be very much less frequent. There are none recorded in my "Vegetable Teratology," in which I endeavoured to render the bibliographical notices as complete as possible up to the time of publication, and there are none that I have hitherto been able to find in any subsequently issued publication. It is quite certain then that ovular changes must be of extremely rare occurrence in Monocotyledons. Another point remains to be mentioned—the ovules or their abortive representatives were decidedly pendulous from the ventral suture, but in the same carpel it often happened that two flat, tongue-shaped, petaloid processes projected one on each side vertically upwards from the base of the ventral suture, but quite free from it above their point of origin. These may be the representatives of ovules in spite of their different direction, for a different position of the ovules in the same carpel is by no means an uncommon circumstance, though I am not aware that it has ever been observed in *Dianella*. Naturally one is disposed to connect them with the petaloid plates projecting from the placenta above described; but unfortunately I was unable to find any intermediate condition between the petal-like plates attached to the placenta for its whole length and those which arose from the base of the carpel free throughout their entire length. It is to be hoped that this variety may have been introduced into our conservatories, where, independently of the opportunity for more complete investigation that would thus be afforded, it would be welcomed for the brilliancy of its masses of flowers.

MAXWELL T. MASTERS

MUSICAL SCALES OF VARIOUS NATIONS [1]

AT the Society of Arts yesterday, Sir F. Abel, C.B., F.R.S., Chairman of the Council, in the chair, Mr. Alexander J. Ellis, F.R.S., read a paper on "The Musical Scales of Various Nations," illustrated by playing the scales on his Dichord (a double Monochord, corrected so as to give the true intervals) and five English concertinas, specially tuned by Messrs. Lachenal, which also enabled him to play strains in some of the scales, and by various native instruments lent for the purpose by Rajah Ram Pal Singh, Mr. A. J. Hipkins, and Mons. V. Mahillon. The nations represented were chiefly those of ancient Greece, Arabia, India, Java, China, and Japan, with rapid glances at subordinate places. The relation to his former paper on the History of Musical Pitch was this, that whereas that paper gave the variations in the pitch of the European tuning note, the present endeavoured to discover the system by which different nations tuned. This was obtained when possible by theory, taking as authorities Prof. Helmholtz for ancient Greece; Prof. J. P. N. Land, of Leyden, for Arabia and Persia, and Rajah Sourindro Mohun Tagore for India. When theory was not possible, results were obtained by measuring with his series of 100 tuning-forks the pitch of the notes produced by instruments of fixed tones (as the wood and metal bar harmonicons in Java and elsewhere), or those produced by native players on other instruments (as by Rajah Ram Pal Singh for India, the musicians of the Chinese Court of the Health Exhibition, and of the Japanese village). In obtaining these pitches Mr. Ellis was materially aided by the delicate ear of Mr. A. J. Hipkins, who most kindly cooperated with him in every way. From the pitches thus obtained, the intervals were expressed in hundredths of an equal Semitone (for brevity called cents) of which 1200 make an Octave, 702 a perfect Fifth, 498 a perfect Fourth, 386 and 316 perfect major and minor Thirds. Then these were plotted down on the movable fingerboards of the Dichord, and the scales were made audible. Occasionally forks were constructed of the pitch observed, and from them concertinas were constructed, and thus the most unusual intervals were reproduced to the ear, and their exact relation to those on a well-tuned piano rendered sensible to the eye. After rapidly exhibiting the ancient and later Greek scales, Mr. Ellis turned to Arabia, for which Prof. Land had furnished the data in his *Gamme Arabe* read before the Oriental Congress at Leyden. This showed first the Pythagorean scale, and then its modification by the lutist Zalzal, 1000 years ago, whereby a fret was introduced between those for E flat, 294 cents, and E, 408 cents (supposing the open string to be C), producing the neutral Third of 355 cents, so that the scale became C 0, D 204, E neutral 355, F 498 cents, followed by the same a Fourth higher, and by a whole tone. This was the system prevalent at the time of the Crusaders, who seem to have brought it to Europe in the shape of the bagpipe, and it is still preserved on good highland bagpipes (as those of Glen and Macdonald) as was proved by taking the scale of one kindly played by Mr. C. Keene, the artist. After the time of the Crusades, Arab theorists, scandalised at giving up the series of Fourths to produce the neutral Thirds and Sixths, carried on the system of Fourths to 17 notes, using 384 and 882 cents for Zalzal's 355 and 853 cents, but preserving his name. So came about the mediæval Arabic system of 17 notes to the Octave, from which 12 scales were constructed, of which Mr. Ellis was able to play 10 on one of his concertinas. But Zalzal's system did not die out, and in 1849 Eli Smith, an American Missionary at Damascus, translated a treatise by Meshâqah, a learned contemporary musician, showing that it led to the division of the Octave into 24 Quarter-tones, with the normal scale of 0, 200, 350, 500, 700, 850, 1000, and 1200 cents, while the player was allowed, in certain cases, to increase or diminish the interval by 50 cents, or a Quarter-tone. Eli Smith gives 95 Arabic airs in this system, of which a few were played on a special concertina. The two important points of Arabic music were the introduction of the neutral Third and Sixth, and the variation of normal notes by a Quarter-tone, both thoroughly inharmonic.

In India the ancient scale was the same as our just major scale, with the exception of the Sixth, which was a comma sharper. Hence it had C 0, D 204, E 386, F 498, G 702, A 906, B 1088, C 1200 cents. But then the major Tones were considered to be divided into 4 degrees, the minor Tones into 3, and the Semitone into 2 degrees, and tones were depressed by 1, 2, or 3, and in one case F, raised by 2 or 3 degrees, and thus the 12 changing notes were produced, answering to our 5 chromatic notes, with 7 notes altered by a degree from them, equivalent to the similar process in the Arabic scale. In modern times the scale was simplified by dividing the distance C to F on the finger-board into 9 equal parts, and from F to *c* (the Octave) into 13 equal parts, and then dividing the 22 degrees among the notes thus: (where the figure before the note indicates the number of

[1] Contributed by the Author.